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XXI.—*Observations on the Nidification of Gasterosteus aculeatus and Gasterosteus spinachia.* By ALBANY HANCOCK*.

It is only within the last few years that naturalists have clearly determined that some species of fish make nests for the reception of their spawn; though Aristotle was actually acquainted with the fact about twenty-two centuries ago.

Five or six kinds are now ascertained to nidify; and of these, two belong to the genus *Gasterosteus*,—one, *G. aculeatus*, the Three-spined Stickleback; the other, *G. spinachia*, the Fifteen-spined Stickleback. The former is a well-known, active, and pugnacious little fish, inhabiting almost every pool and rivulet in the kingdom; the latter is much rarer, and is a denizen of the sea.

Mr. Jonathan Couch states, in his interesting work entitled 'Illustrations of Instinct,' that the first detailed notice of the nest-building of the Three-spined Stickleback occurs in a little magazine, 'The Youth's Instructor,' for the year 1834. This notice is from the pen of Mr. T. Crookenden, a gentleman unknown as a naturalist; but who has given a very faithful account, so far as it goes, of the nidification of this species. It contains all that is at present known on the subject, and its accuracy can be verified by any one who will take the trouble to look into almost any pool of water during the summer months,—the breeding season of the Stickleback. At this time, these fish will be observed near to the margins, busily engaged in building and guarding their nests; and shoals of the fry may be seen, in different stages of development, swimming about in all directions. But if we wish to study, to advantage, the nidification of this

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species, a few specimens should be placed in confinement about May or June; and then all their movements can be narrowly watched and accurately observed. Care must be taken, however, that they be left unmolested, and that their new abode resemble, as much as possible, their usual haunts. I have lately had an opportunity of noticing the habits of this fish, during the breeding season, under the above favourable conditions.

We have, for some time past, kept a glass trough filled with aquatic plants and animals; the bottom of this vessel is covered with mud, and the rock-work, piled up in the centre, is overgrown with a delicate hair-like *Conferva*; a few floating plants spread over the surface of the water, and innumerable *Entomostraca* and other small Crustaceans, as well as various animalcules, swarm in all parts; the minute, but deadly, poison-armed *Hydra* also prevails where food is so plentiful; and a solitary individual of the great water beetle, *Dytiscus marginatus*, rambles over its watery domain, lord and master of all. Several of the freshwater Mollusca also people the trough, which on the whole has much the appearance of a miniature pond. Into this new home were put four or five sticklebacks last May; and they, at once, made themselves perfectly at ease. One, without the least hesitation, took possession of a certain spot, which it guarded with the greatest pertinacity, attacking vigorously any of its companions that might happen to approach the chosen locality. The beetle too, which sometimes came slowly paddling by, was pounced upon and unceremoniously tumbled over; but secure within his scaly armour, as the knights of old, he little heeded the onslaught of his naked assailant; so overpowering all opposition he scrambled onward in his undeviating path.

This fish was rather small, had the throat of a bright red colour, and the eyes of a brilliant bluish green. At first, all the others were pale; but, in the course of a few days, one of them gradually assumed the rich hues of that just described, and soon afterwards it also became attached to a spot, taking up its abode in one of the corners of the trough. On examining attentively the two selected localities, a nest was found in each, composed of a collection of delicate vegetable fibres, resting on the bottom of the trough, and matted into an irregularly circular mass, somewhat depressed, and upwards of an inch in diameter; the top being covered over with the same materials, and having, in the centre, a large hole. The fishes scarcely ever strayed from their nests, but were constantly on guard, defending or repairing them; they were perpetually prying into the hole at the top and thrusting their heads right into it. On one occasion, one of them entered by this hole, and slowly forced itself right through the side of the nest: as it gradually moved onward, its

body had a peculiar, lateral, vibratile motion. They would frequently seize hold of the nest and give it a violent tug, shaking and tearing loose the vegetable matter of which it was composed; at other times they would carry to it, in their mouths, fine *Conferva*-stems, and press them with considerable force into the walls of the nest, or thrust them into the hole, which, by this means, was sometimes partially concealed. Occasionally, each was observed hovering over its nest, with the head close to the orifice, the body being inclined upwards, at an angle of about 45° , fanning it with the pectoral fins, aided by a lateral motion of the tail. This curious manœuvre was apparently for the purpose, so to speak, of ventilating the spawn, which could be distinctly seen through the orifice at the top; at least, by this means, a current of water was made to set in towards the nest, as was rendered perfectly evident by the agitation of particles of matter attached to it. This fanning or ventilating process was repeated, at short intervals, during the day, and every day until the spawn was hatched, to accomplish which took between two and three weeks.

Only one nest contained spawn; the other was torn in pieces, and the materials scattered about, in the hope that we might have the pleasure of seeing it reconstructed. In this we were not disappointed; the fish immediately began to form a new nest in exactly the same spot, and by the following day it was more than half completed. It took a mouthful at a time, and was at some pains in adjusting each load, spreading the materials out, and pressing them down with its mouth; it then drew its body slowly over the whole, vibrating, all the time, in the same peculiar manner as when it forced its way through the nest, as before stated*.

On the 13th of June the hole at the top of the fruitful nest was found to be much enlarged, so that the entire mass of spawn was exposed to view; and, on looking attentively, a few of the newly hatched fry were seen flitting about the walls of the nest. The assiduity of the parent was now greatly increased; it never left the spot; by night it rested either on the nest or by its side, and during day nothing was allowed to approach. It fiercely seized a quill that was passed down towards the object of its solicitude, with such vigour that the shock of attack was distinctly felt by the hand. Combats with its companions became more frequent; but its ire was chiefly directed against its neighbour, which, like itself, was engaged in parental duties. This having also a nest to defend never shrank from the conflict,

* It is probable that it is the male fish which builds and guards the nest; and, if so, it might, perhaps, be shedding the milt when dragging its body over and through the nest in the manner described.

and the encounters were therefore fierce and prolonged; but, nevertheless, conducted with all due caution, and apparently with much science, as the gentlemen of the ring would express it. The sparring was very wary, and generally lasted a few seconds before the combatants closed. The attack was usually commenced by one quietly creeping up, watching its opportunity; on this, the other, acting on the defensive, would turn its broad side to the enemy and raising the ventral spine wait to receive the onslaught; the assailant, intimidated by this formidable demonstration, would then slowly retreat, and in its turn had in the same manner to defend itself. After thus advancing and retreating for a few times, one, taking advantage of an unguarded moment, would rush in upon its opponent and butt at it with its head, apparently endeavouring to bite; the other, rallying, returned the compliment, and after dashing at each other in this way two or three times, with extraordinary rapidity, the round would terminate, and each fish retreat to its nest to recommence its more immediate nidimental duties.

The fry were, at first, so minute and transparent that they could scarcely be discerned as they lay partially concealed amid the meshes of the nest: every now and then a slight fluttering motion betrayed their position, otherwise it was almost impossible to distinguish them. As I was closely watching their motions, at this time, one of the newly hatched fishlings, with intrepidity beyond its experience, ventured to pass the limits of its cradle: in an instant the watchful parent was there, and with gaping mouth seized the little wanderer, which immediately disappeared, the jaws having closed upon it. Seeing this, I at once gave up the fry for lost, deeming that here was an instance of instinct at fault, and that all the affectionate solicitude of the parent was to end in its devouring its offspring. In this I was mistaken: the old fish, quietly returning, dropped the straggler into its nest lively and uninjured. During the whole of this day none of the fry were permitted to ramble beyond the precincts of their fold; when any attempted to do so—and many did attempt—they were invariably brought back in the mouth of the parent: none escaped its vigilant eye, and it was amusing to see with what a hurried, fluttering motion the little things dropped almost perpendicularly down into the nest, so soon as they were released from the jaws of the parent.

It was three days before all the eggs were hatched, and the attention of the parent, during all this time, was unremitting. On the second day I marked its manœuvres for five minutes, and found that, in this short period, it ventilated the nest eight times, warded off an attack of the neighbouring fish, and brought back to the nest a straggler or two. During this day

the spawn was frequently examined by the parent, who would occasionally seize hold of it and give it a good shake; apparently for the purpose of throwing off adherent matter, that the water might freely circulate about the eggs. The parent would then dive, head foremost, into the nest and bring out a mouthful of mud, which it would carry to some little distance and discharge with a puff.

The third day was passed much in the same manner, only as the eggs were now all hatched, the nest was less frequently fanned or ventilated; and the fry, about forty in number, were allowed greater liberty; the strongest being permitted to recreate themselves among the Confervæ that grew on a stone about 2 inches from the nest. On the fourth day the fanning had ceased altogether, and the rambles of the young were less restricted. They were not yet, however, permitted to pass beyond certain limits; when any transgressed these bounds they were immediately seized, as heretofore, and carried back to the nest; into which they were always very glad to escape from the clutches of their ardent parent. Notwithstanding all her vigilance, one contrived, on the fifth day, to escape her eye, and passing the fatal boundary was immediately devoured by the other fish, which now seemed always on the watch, neglecting its own barren nest, being intent only on appropriating to itself the nestlings of its fruitful neighbour. In this act of cannibalism we see the reason for the parent's anxious care and its jealousy of its kind; and it is evident from Mr. Crookenden's account, previously quoted, that they greedily devour each other's spawn. The young fry, however, have other enemies as well as their own species. One day a favourite *Hydra* (*H. fusca*) was observed to be distended in a most extraordinary manner; on examination it was found to have swallowed the head and shoulders of one of the young fish many times larger than itself; and the caudal extremity, which was too much for it, and which was projecting out of its mouth, had been seized upon by another *Hydra*. Thus, it would appear that these low organized, but powerful and voracious animals occasionally regale themselves on the flesh of the *Vertebrata*. This happened when the fry were three or four weeks old.

All the old fish, with the exception of that with the young, were, in consequence of their cannibal propensities, turned out of the trough; and danger being thus removed, the fry were no longer restricted in their rambles, but enjoyed the whole range of their crystal abode. Henceforth the parent's assiduity gradually relaxed, though for days afterwards it was its custom to take the young occasionally into its mouth, and after carrying them a little distance to let them drop out again. I took one of

the fry out one day for examination with the microscope; on returning it to the trough, it was in so sickly a state as to be scarcely able to leave the vessel, which was held in the hand. The old fish, perceiving the helpless condition of its offspring, came up to the surface of the water, and seizing hold of the exhausted young one carried it off almost from amidst my fingers, and taking it to some distance puffed it out of its mouth into a tuft of *Confervæ*. This courageous act of our little fish would seem, in some measure, to give credence to the assertion, so frequently made, that some of the sharks protect their young by receiving them into the mouth on the approach of danger.

Other facts might be related evincing parental attachment; but perhaps enough has been said to satisfy those, who take an interest in such matters, that in this respect the Three-spined Stickleback is scarcely, if at all, inferior to the hen, whose affectionate regard for her offspring has ever been the theme of admiration. Incubation, with the fish, is out of the question; it attends its nest, however, as diligently as any of the feathered tribes, keeping it in constant repair, fanning it with its fins, and removing anything that might obstruct the free action of the water upon the eggs; it defends its young with the same undaunted courage, and though it cannot gather them under spreading wings as the hen gathers her brood, yet all those which stray are brought back to the nest, that they may be under the protection of their ever-vigilant and courageous parent.

The nest of the Fifteen-spined Stickleback (*Gasterosteus spinachia*) was first noticed by Mr. Jonathan Couch on the Cornish coast in 1842. Since then it has been observed two or three times on the coast of Northumberland. It is composed of pendent seaweeds bound together, by a silk-like thread, into pear-shaped or fusiform masses: the spawn is deposited in the centre of the mass. Mr. Couch says, "One of these nests was visited every day for three weeks, and the old fish was found invariably guarding it; it would examine the nest on all sides, and then retire for a short time, but soon return to renew the examination. On several occasions," continues this gentleman, "I laid the eggs bare by removing a portion of the nest, but when this was discovered great exertions were instantly made to recover them. By the mouth of the fish the edges of the opening were again drawn together, and the other portions torn from their attachments and brought over the orifice till the ova were again hid from view. And as great force was sometimes necessary to effect this, the fish would thrust its snout into the nest as far as the eyes, and then jerk backwards till the object was effected. While thus engaged, it would suffer itself to be taken in the hand, but

repelled any attack made on the nest, and quitted not its post so long as I remained."

Mr. Richard Howse, who found three or four of these nests in a pool among the rocks at Tynemouth, a year or two ago, informs me that each was attended by a fish, and that they scarcely ever left their nests, but kept hovering about, attentively examining them, and thrusting their projecting muzzles amidst the seaweeds of which they were composed; the fish would occasionally poise themselves close to the nests, and fan them with the pectoral fins in the same manner as the Three-spined species. And, indeed, it is quite evident, from the accounts given by these two gentlemen, that the habits of both species, in all that concerns nidification, perfectly coincide; both guard the nest with the same unwearied perseverance, drive off enemies, make all necessary repairs, fan or ventilate the nest, and keep it in all respects in good order.

It is satisfactory to observe this exact similarity of habits, for Mr. Couch has changed his opinion, apparently upon insufficient grounds, respecting the nest, which he attributed to the Fifteen-spined Stickleback. He now considers it to belong to the common Shanny (*Blennius pholis*), arriving at this conclusion after having examined the young hatched from ova taken out of one of the nests. "Being from the first," says this gentleman, "impressed with the conviction that they were the young of the Fifteen-spined Stickleback, I was much surprised to notice the great difference of their shape from that of their supposed parent, more especially in the parts before the eyes, which, instead of being elongated and slender, were short and round. In consequence of this they were closely examined with glasses, and drawn with the aid of a microscope of low power; and though I failed to detect satisfactorily the ventral fins of that fish (chiefly perhaps from their slender form and transparency), yet, from the declivity of the head, protuberance of the belly, the pectoral fin, and the length of the dorsal and anal fins, which in some specimens were continuous with the caudal, and in others separated by a slight notch, I had no hesitation in referring them to the common Shanny."

Now, the young of the Three-spined Stickleback differ just as widely from the mature fish as the young of the Fifteen-spined species are stated to do; and what is of still more importance, the differences are of exactly the same kind. In the former, as well as in the latter, the parts before the eyes are short and round, and can scarcely be said to project at all in front; the declivity of the head is consequently great; the belly is protuberant, and the dorsal and anal fins are long and continuous with the caudal. The young of the Three-spined Stickleback

would therefore appear also to possess, at first, the characters of the Shanny; but as development goes on, the jaws are pushed out, the belly is reduced in comparative size, and the dorsal and anal fins are shortened, and become ultimately separated from the caudal. Thus, in course of time, the young gradually assume the form and characters of the parent. And there can be little doubt that this would have been found to be the case with the young of the Fifteen-spined Stickleback, had Mr. Couch watched their development a little longer. The obtuse form of the head, on which that gentleman places much stress, is the embryonic condition of all fishes; the elongation of the jaws is always an after-development.

In conclusion it may be remarked, that of the three or four other species of fish, described to nidify, one, a native of Demerara, is stated to remain by the side of the nest with as much solicitude as the hen guards her eggs; the same is said respecting another species inhabiting the Black Sea: but in none, so far as I am aware, has parental attachment been observed to equal that evinced by the Three-spined Stickleback. Yet we must not, therefore, conclude that it does not exist to the same extent in others of the finny tribes. The habits of these animals are very little known; and who can say what time may bring to light respecting the *œconomy* of the inhabitants of the deeper regions of the sea? It is only, as it were, the other day that nothing was known of the nidification of the Three-spined Stickleback,—a resident of almost every pool, river, and rivulet in the kingdom.

XXII.—*A Catalogue of British Spiders, including remarks on their Structure, Functions, Œconomy, and Systematic Arrangement.* By JOHN BLACKWALL, F.L.S.

[Concluded from p. 189.]

198. *Epëira bicornis*.

Epëira bicornis, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 124; Blackw. Linn. Trans. vol. xix. p. 126; Koch, Die Arachn. B. xi. p. 92. tab. 382. fig. 902, 903.

— *arbustorum*, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 3.

In the wooded parts of Denbighshire this rare species occurs on the trunks of trees. It pairs in June, and in July the female constructs a subglobose cocoon of light brown silk of a loose texture, about $\frac{1}{3}$ rd of an inch in diameter, which includes her eggs.